

COUPP Acoustic Breakout Box

Preliminary Conceptual Design Report

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2/15/2010

This document is a conceptual design report for the breakout box for the acoustic detector signals for the COUPP-60kg chamber MINOS commissioning run. Each acoustic sensor is serviced by a 3-twisted pair cable which carries bias voltages and returns plus a single twisted pair for the signal output. The acoustic breakout box is an 8-channel device servicing 8 separate acoustic transducers. It provides termination for the primary 3-pair cable. It supplies the biasing voltages for the pre-amplifiers and extracts the acoustic signals which are presented to the front panel for digitization. This box is essentially a clone of the device used on the COUPP-2L bubble chamber, but with 8 channels instead of 4.

Introduction

The acoustic breakout box for the COUPP-2L chamber was constructed on the basis of specifications for the COUPP-2L preamps. The box supplied +5 Volts, -5 volts, and ground for the voltage bias, and signal+ and signal- for the output signals. In the assignment of pins and cable pairs, we chose a 6-pin military spec connector and 3-twisted-pair cables. We chose to pair +5 and +5 return, -5 and -5 return, and signal+/signal-. Since the detector itself has only five wires (+5, -5, ground, signal+, signal-,) we connected both power return wires together and to the sensor ground wire in the wiring internal to the chamber. I treated the signal ground as being distinct from the power ground, although I believe that these signals are actually connected inside the sensor packaging. The front panel of the device preserves the ground separation, using isolated-ground BNC cables. When the signals are ultimately received on the digitizer, they are treated as differential signals. A schematic of one channel of the COUPP-2L breakout box is shown in Figure 1.

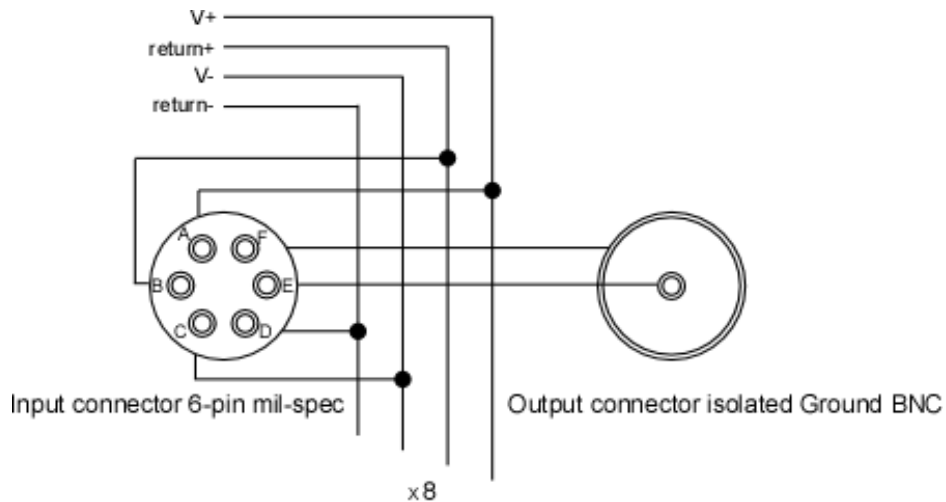


Figure 1: Schematic of a typical Acoustic Breakout Box channel. The input pin assignments are indicated. At the breakout box, V+ and return+ are paired as are V- and return-. The power grounds are also kept separate from the signal ground.

The COUPP-2L Implementation

For COUPP-2L, we constructed a simple 4-channel box. The box is shown in detail in Figure 2. The box uses two Polytron linear encapsulated power supply modules to supply the plus and minus 5 Volt bias voltages. The specification sheet for the Polytron linear power supplies is included as Appendix I. Each of the supplies is floated, and each is simply connected to the parallel combination of the bias voltage pins for each of the four channels. For better or for worse, there is no bypassing or other isolation separating the individual channels within the box. The box is equipped with an integrated power cord / fuse holder to provide appropriately protected AC to the Polytron supplies. The front panel is provided with a power switch and indicator LEDs for the two voltages. Connections from the acoustic sensors arrive at the back of the module via 6-pin mil- spec connectors. The signal and signal ground pins from the sensor are passed across the breakout box to the front panel isolated ground BNC connectors.

Specifications for the COUPP-2L Module

- 1) Number of channels = 4
- 2) Bias Power Supply Specifications
 - a. Power + = +5 volts, Power - = -5 volts. 1000 ma supply capability.
 - b. Encapsulated linear power supply
 - c. Ripple <1mV rms
- 3) Rear panel connector specification – AMPHENOL 0722 MS3120E-10-6S
 - a. Pin assignments
 - i. Pin A = power +
 - ii. Pin B = return +
 - iii. Pin C = power –
 - iv. Pin D = return –
 - v. Pin E = signal +
 - vi. Pin F = signal –
- 4) Four (4) isolated ground BNC front panel outputs
- 5) Integrated AC cord / fuse holder assembly.
 - a. 1/8 amp slow blow fuse
- 6) Front Panel LEDs for plus and minus voltages.



Figure 2: The COUPP-2L breakout box. Top is a view looking down into the open 1-U chassis. Next image is the front panel showing the isolated ground BNC outputs, power switch, and front-panel LEDs. Next is the back panel showing the integrated fuse holder/AC cord connector and the 6-pin mil-spec inputs connectors. The bottom image is a detail of the input connectors.

The COUPP-60kg Implementation

- 1) For COUPP-60kg, we need an eight-channel box. The box should be largely similar to the COUPP-2L unit shown in Figure 2 except for the channel count. The choices of input and output connectors, AC cord, fuse holder, and power switch have proved acceptable in the 2L implementation. These should be kept the same. *The indicator LEDs as delivered were too bright and were modified in the field. This should be corrected in the 60kg unit.*
- 2) *The choice of the Polytron linear encapsulated power supply modules to supply the bias voltages should be revisited.* An assessment of the voltage, current, and ripple requirements should be made based on the pre-amplifier design and channel count.
- 3) The basic architecture should be kept the same. Each supply should be floated, and each should be simply connected to the parallel combination of the bias voltage pins for each of the eight channels. *The question of bypassing and or channel-to-channel power isolation should be revisited.*

Specifications for the COUPP-2L Module

- 1) Number of Channels = 8
- 2) Power Supply Specifications
 - a. Power + = +5volts, Power - = -5 volts. [1000 ma supply capability.]
 - b. Encapsulated linear power supply
 - c. [Ripple <1mV rms]
- 3) Rear panel connector specification – AMPHENOL 0722 MS3120E-10-6S
 - a. Pin assignments
 - i. Pin A = power +
 - ii. Pin B = return +
 - iii. Pin C = power –
 - iv. Pin D = return –
 - v. Pin E = signal +
 - vi. Pin F = signal –
- 4) Eight (8) isolated ground BNC front panel outputs
- 5) Integrated AC cord / fuse holder assembly.
 - a. [1/8 amp slow blow fuse (or other as appropriate for Power supply choice)]
- 6) Front Panel LEDs for plus and minus voltages.

Project Details, Specific Deliverables:

- 1) The first bureaucratic step in this effort is for the COUPP project manager to approve this conceptual design report.
- 2) The second bureaucratic step in this effort is for the assigned electrical Engineer to review this document and to provide an assessment of the engineering time and effort required to complete item (4) below.
- 3) The third bureaucratic step in this effort is for the COUPP project manager to approve the engineering effort assessment in (2)
- 4) The first technical step in the project is an engineering assessment of the power supply requirements based on the details of the pre-amplifier design. The specific deliverable here is a set of detailed specifications for the COUPP-60kg acoustic breakout box. These specifications should include
 - a. A schematic for the circuitry
 - b. Drawings for the mechanical aspects of the box including mounting, front and rear panels, etc.
 - c. A parts list.
- 5) A final design report should be produced. This report should include
 - a. An overview of the design considerations and the choices that were made.
 - b. Details of any relevant engineering calculations
 - c. The specifications for the module
 - d. Cost estimates derived from the parts list
 - e. An assessment of the effort required for procurement and assembly
 - f. A schedule for the completion of the module, based on estimated parts delivery and time required for assembly of the module.
- 6) The final design report along with all procurement materials (purchase requisitions, sole source, etc) should be provided to the COUPP project manager for approval.
- 7) The final deliverable, obviously, is the Box. Assembled, tested, certified.

Appendix I: Polytron Linear Encapsulated Power Module Data Sheet



POLYTRON DEVICES, Inc.

LINEAR ENCAPSULATED POWER MODULES

REGULATED 5Vdc-250Vdc
P.C. CARD OR CHASSIS MOUNTING



FEATURES

- UL, CE & CSA
Approved (All Models)
- Regulation Line &
Load 0.2% to 0.02%
- P.C. Card/Chassis
Mounting
- High Isolation Voltage
Available
- Short Circuit
Protection
- Single, Dual & Triple
Outputs
- Finger Safe Terminal
Available

P3, P5 Series

Specifications

115 Vac, 50 to 400 Hz @ 25°C

INPUT

Voltage Range.....105-125 Vac, 50-60 Hz
.....400Hz available

OUTPUT

Voltage Accuracy @ FL for Singles,±1.0%
Line Regulation: Single Output.....±0.2%
Load Regulation: Single Output.....±0.2%
Temperature Coefficient.....±0.02%/°C typ.

GENERAL

Isolation Resistance.....50MOhms
Protection.....Short Circuit Protection

ENVIRONMENTAL

Operating Temperature Range.....-25 to +71°C
.....-40 to +85°C Optional
Storage Temperature Range.....-25 to +85°C
Cooling.....Free Air Convection

PHYSICAL

Dimensions.....See Chart and Diagrams

1. Case style ending with letter "T"(Chassis mounted units with terminal barrier strip) are designated by the suffix "T". Case styles A,B,C,D,G and E (PC card mounting) do not require suffixing.
2. **Most competitors pinouts available--contact factory.**
3. For 400HZ, use suffix "04" after model number.
4. For wide operating temperature range, use "W" suffix after model number.

FAST DELIVERY

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Selection Guide

(Continued)

	Output (Vdc)	Output Current (mA)	Regulation		Ripple & (mV rms)	Case	Model Number	Slow Blow (A)	
			Line	Load					
SINGLE OUTPUT VOLTAGE	5	200	0.20%	0.20%	1.0	G, 1GI	P34-5SM	1/32	
		500	0.20%	0.20%	0.5	A, 1AI	P37	1/16	
		500	0.02%	0.05%	0.5	A, 1AI	P37-1	1/16	
		1000	0.20%	0.20%	1.0	B, 1BI	P38	1/8	
		1000	0.02%	0.05%	1.0	B, 1BI	P38-1	1/8	
		1000	0.02%	0.05%	0.5	C, 1CI	P38/1.56	1/8	
		2000	0.02%	0.10%	1.0	C, 1CI	P39	1/4	
		3000	0.02%	0.15%	1.0	D, 1DI	P39-3	3/8	
	10	120	0.10%	0.10%	1.0	E, 1EI	P33-10SM	1/32	
		150	0.10%	0.10%	1.0	A, 1AI	P33-10S	1/16	
		250	0.10%	0.10%	1.0	B, 1BI	P34-10S	1/16	
		500	0.02%	0.05%	0.5	C, 1CI	P37-10S	1/8	
		1000	0.02%	0.05%	0.5	D, 1DI	P38-10S	3/8	
		1500	0.02%	0.05%	0.5	D, 1DI	P38-10SA	1/4	
	12	100	0.10%	0.10%	1.0	E, 1EI	P32-12SM	1/32	
		120	0.02%	0.10%	1.0	A, 1AI	P33-12S	1/16	
		200	0.10%	0.10%	1.0	B, 1BI	P34-12S	1/16	
		500	0.02%	0.10%	0.5	C, 1CI	P37-12S	1/5	
		1000	0.10%	0.10%	1.0	D, 1DI	P38-12S	3/10	
		80	0.10%	0.10%	1.0	E, 1EI	P33-15SM	1/32	
	15	120	0.02%	0.10%	1.0	A, 1AI	P33-12S	1/16	
		200	0.10%	0.10%	1.0	B, 1BI	P34-15S	1/10	
		300	0.10%	0.10%	1.0	C, 1CI	P35-15S	1/8	
		500	0.02%	0.10%	0.5	C, 1CI	P37-15S	1/5	
		800	0.02%	0.10%	1.0	D, 1DI	P38-15S	3/10	
		50	0.10%	0.10%	1.0	E, 1EI	P32-18SM	1/32	
	18	50	0.02%	0.05%	1.0	A, 1AI	P32-18S	1/32	
		100	0.02%	0.05%	1.0	B, 1BI	P33-18S	1/16	
		50	0.10%	0.10%	1.0	E, 1EI	P32-24SM	1/32	
	24	100	0.10%	0.10%	1.0	A, 1AI	P33-24S	1/16	
		200	0.10%	0.10%	1.0	B, 1BI	P34-24S	1/8	
		300	0.10%	0.10%	1.0	C, 1CI	P35-24S	1/5	
		500	0.10%	0.10%	1.0	D, 1DI	P37-24S	1/4	
		800	0.10%	0.10%	1.0	H, 1HI	P38-24S	3/8	
		1000	0.10%	0.10%	1.0	H, 1HI	P39-24S	1/2	
	48	50	0.20%	0.20%	2.0	B, 1BI	P32-48S	1/16	
		100	0.20%	0.20%	2.0	B, 1BI	P33-48S	1/8	
		200	0.20%	0.20%	2.0	C, 1CI	P34-48S	1/4	
	50	50	0.05%	0.20%	2.0	B, 1BI	P32-50S	1/16	
		100	0.05%	0.20%	2.0	B, 1BI	P33-50S	1/8	
		200	0.05%	0.20%	2.0	C, 1CI	P34-50S	1/4	
		300	0.20%	0.20%	3.0	D, 1DI	P35-50S	3/8	
	75	35	0.05%	0.20%	2.0	B, 1BI	P32-75S	1/10	
		70	0.05%	0.20%	2.0	B, 1BI	P33-75S	1/5	
		150	0.05%	0.20%	2.0	C, 1CI	P34-75S	3/10	
		200	0.10%	0.20%	3.0	D, 1DI	P35-75S	3/8	
	100	25	0.05%	0.20%	2.0	B, 1BI	P32-100S	1/16	
		50	0.05%	0.20%	2.0	B, 1BI	P33-100S	1/8	
		100	0.05%	0.20%	3.0	C, 1CI	P34-100S	1/4	
		150	0.10%	0.20%	3.0	D, 3DI	P35-100S	3/8	

1. Case style ending with letter "T" (Chassis mounted units with terminal barrier strip) are designated by the suffix "T". Case styles A,B,C,D,G and E (PC card mounting) do not require suffixing.
2. Most competitors pinouts available--contact factory.
3. For 400HZ, use suffix "04" after model number.
4. For wide operating temperature range, use "W" suffix after model number.



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Selection Guide

(Continued)

	Output (Vdc)	Output Current (mA)	Regulation		Ripple & (mV rms)	Case	Model Number	Slow Blow (A)	
			Line	Load					
SINGLE OUTPUT	150	17	0.05%	0.20%	2.0	A, 1AI	P32-150S	1/16	
		35	0.05%	0.20%	3.0	B, 1BI	P33-150S	2/10	
		70	0.05%	0.20%	3.0	C, 1CI	P34-150S	1/4	
		100	0.20%	0.20%	3.0	D, 1DI	P35-150S	3/8	
	180	15	0.05%	0.20%	3.0	B, 1BI	P32-180S	1/16	
		30	0.05%	0.20%	3.0	B, 1BI	P33-180S	1/5	
		55	0.05%	0.20%	3.0	C, 1CI	P34-180S	1/4	
		80	0.10%	0.20%	3.0	D, 1DI	P35-180S	3/8	
	200	12	0.05%	0.20%	3.0	B, 1BI	P32-200S	1/16	
		25	0.05%	0.20%	3.0	B, 1BI	P33-200S	1/8	
		50	0.05%	0.20%	3.0	C, 1CI	P34-200S	1/4	
		75	0.10%	0.20%	3.0	D, 1DI	P35-200S	3/8	
	250	10	0.05%	0.20%	3.0	B, 1BI	P32-250S	1/16	
		20	0.05%	0.20%	3.0	B, 1BI	P33-250S	1/8	
		40	0.05%	0.20%	3.0	C, 1CI	P34-250S	1/4	
		60	0.10%	0.20%	3.0	D, 1DI	P35-250S	3/8	
DUAL OUTPUTS	±5	±50	0.02%	0.02%	1.0	A, 2AI	P32-5	1/32	
		±100	0.10%	0.10%	1.0	A, 2AI	P33-5	1/32	
		±200	0.10%	0.10%	1.0	B, 2BI	P34-5	1/16	
		±300	0.02%	0.05%	0.5	C, 2CI	P35-5	1/10	
		±500	0.02%	0.05%	0.5	C, 2CI	P37-5	1/8	
		±1000	0.01%	0.10%	1.0	D, 2DI	P38-5	1/4	
	±8	±500	0.10%	0.10%	82.0	D, 2DI	P37-8	1/5	
		±100	0.02%	0.05%	82.0	A, 2AI	P33-10	1/16	
	±12	±25	0.10%	0.10%	2.0	G, 1GI	P31-12M	1/32	
		±25	0.02%	0.05%	5.0	A, 2AI	P31-12	1/32	
		±50	0.02%	0.05%	5.0	A, 2AI	P32-12	1/32	
		±100	0.10%	0.10%	1.0	A, 2AI	P33-12	1/16	
		±200	0.10%	0.10%	1.0	B, 2BI	P34-12	1/8	
		±300	0.10%	0.10%	1.0	C, 2CI	P35-12	1/5	
		±500	0.10%	0.10%	1.0	D, 2DI	P37-12	3/10	
		±800	0.10%	0.10%	1.0	D, 2DI	P38-12	2/5	
		±25	0.10%	0.10%	2.0	G, 1GI	P31-M	1/32	
		±25	0.20%	0.20%	1.0	A, 2AI	P31	1/32	
	±15	±25	0.02%	0.02%	0.5	A, 2AI	P31-1	1/32	
		±50	0.20%	0.20%	1.0	A, 2AI	P32	1/16	
		±50	0.02%	0.02%	0.5	A, 2AI	P32-1	1/16	
		±100	0.20%	0.20%	1.0	A, 2AI	P33	1/10	
		±100	0.02%	0.02%	1.0	A, 2AI	P33-1	1/10	
		±200	0.20%	0.20%	1.0	B, 2BI	P34	1/5	
		±200	0.02%	0.05%	1.0	B, 2BI	P34-1	1/5	
		±350	0.20%	0.20%	1.0	C, 2CI	P35	1/4	
		±350	0.02%	0.05%	1.0	C, 2CI	P35-1	1/4	
		±500	0.10%	0.10%	1.0	D, 2DI	P37-15	3/8	
	±18	±800	0.10%	0.10%	1.0	D, 2DI	P38-15	1/2	
		±50	0.10%	0.10%	1.0	A, 2AI	P32-18	1/16	
		±100	0.10%	0.10%	1.0	B, 2BI	P33-18	1/10	
	±24	±50	0.10%	0.10%	1.0	B, 2BI	P32-24	1/16	
		±100	0.10%	0.20%	1.0	B, 2BI	P33-24	1/8	
		±200	0.10%	0.20%	1.0	C, 2CI	P34-24	1/4	
		±200	0.10%	0.20%	1.0	C, 2CI	P34-24	1/4	
TRIPLE VOLTAGE	5±12	250/±60	0.02%	0.10%	1.0	C, 3CI	P51-12	1/10	
		250/±120	0.02%	0.10%	1.0	C, 3CI	P52-12	1/10	
		300/±180	0.02%	0.10%	1.0	C, 3CI	P53-12L	1/5	
		500/±120	0.02%	0.10%	1.0	C, 3CI	P53-12	1/5	
		1000/±150	0.02%	0.10%	1.0	D, 3DI	P53-1280	1/4	
	5±15	250/±50	0.02%	0.10%	1.0	C, 3CI	P51-15	1/10	
		250/±100	0.02%	0.10%	1.0	C, 3CI	P52-15	1/10	
		300/±150	0.02%	0.10%	1.0	C, 3CI	P53-15L	1/5	
		500/±100	0.02%	0.10%	1.0	C, 3CI	P53-15	1/5	
		1000/±150	0.02%	0.10%	1.0	D, 3DI	P53-1580	1/4	

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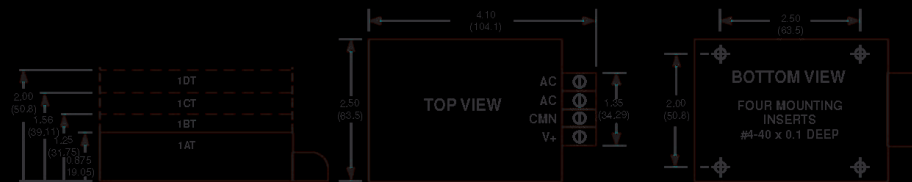
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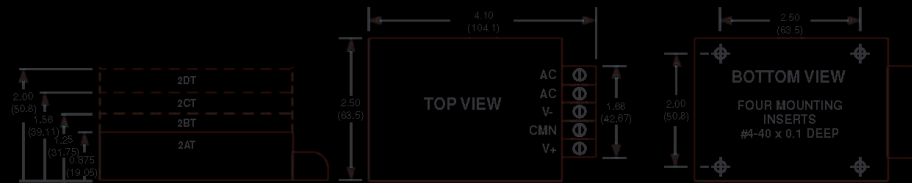
Power Supply Options

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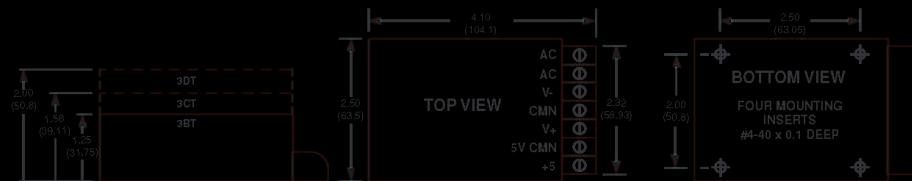
CHASSIS MOUNTED UNITS



SINGLE OUTPUT MODELS



DUAL OUTPUT MODELS

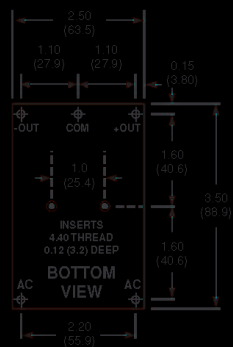


TRIPLE OUTPUT MODELS

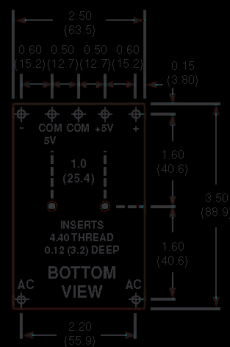
All Dimensions are in inches (mm)

ALTERNATE PIN-OUT

SINGLE & DUAL OUTPUT MODELS

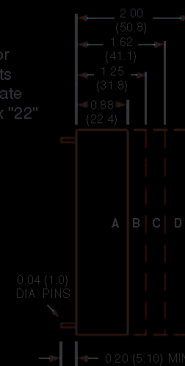


TRIPLE OUTPUT MODELS



Note:
* No connection for single output units
* To specify alternate pin-out use suffix "22"

SIDE VIEW



All Dimensions are in inches (mm)

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